Energy, Mines and Resources Canada | Énergie, Mines et Ressources Canada

CANMET

Canada Centre for Mineral and Energy Technology | Centre canadien de la technologie des minéraux et de l'énergie

MINERALOGICAL AND IMAGE ANALYSIS STUDY OF A MAGNETITE CONCENTRATE FROM THE LAKE ST. JOE IRON DEPOSIT

W. Petruk, D. Owens and R.G. Pinard
Ore Processing Laboratory

This document ... (CANMET) ... Énergie (CANMET)

June 1981

Project: MRP-3.4.0.0.03
Iron Ore Processing

MICROMEDIA

DECLASSIFIED
DATE 30/09/86
AUTHORIZED BY

CONFIDENTIAL

13pp
MINERALS RESEARCH PROGRAM
MINERAL SCIENCES LABORATORIES
DIVISION REPORT MRP/MSL 81-4 (CF)

MINERALOGICAL AND IMAGE ANALYSIS STUDY OF A MAGNETITE CONCENTRATE FROM THE LAKE ST. JOE IRON DEPOSIT

by

W. Petruk, D. Owens and R.G. Pinard

INTRODUCTION

Six sized-fractions of a magnetite concentrate from the Lake St. Joe iron deposit were received from J.M.D. Wilson of the Mineral Dressing Section. Mr. Wilson requested a mineralogical and image analysis study of the samples, in particular a determination of the mode of occurrence of the K-bearing minerals, and the degree of liberation of magnetite.

The work was undertaken as part of Project 3.4.0.0.03 - Iron Ore Processing. Partial chemical analyses of the samples are listed in Table 1.

Table 1 - Chemical Analyses of Magnetite Concentrate*

	Sample Designation					
Constituent	Unsized	+200M	200-270M	270-400M	400-500M	-500M
Total Fe, %	69.53	**	64.79	68.70	69.84	70.25
Soluble Fe	68.91	**	64.89	68.29	69.32	69.94
SiO_2	3.01	10.74	8.67	3.91	2.75	1.90
K_2O	0.06	0.16	0.12	0.07	0.06	0.05
Na_2O	0.05	0.14	0.11	0.06	0.04	0.03
P	0.017	**	0.024	0.022	0.020	0.017

* Chemical Laboratory, MSL, Report No. 81-0268

** Insufficient material for analysis

SAMPLES AND METHOD OF ANALYSIS

The samples received were labelled as: plus 200 mesh; 200 to 270 mesh; 270 to 400 mesh; 400 to 500 mesh; minus 500 mesh; and unsized sample of the concentrate. They were analysed by X-ray diffractometer to determine the major minerals. Polished sections were prepared and studied by optical microscope and scanning electron microscope (SEM). The non-metallic minerals could not be differentiated from the mounting medium in polished section, but they were clearly defined on the electron backscatter image (EBS) of the SEM. Four EBS photographs were taken at random locations on each polished section and the minerals in the photographs were identified with the SEM. The photographs were analysed with the Quantimet 720 image analyser to determine mineral quantities and liberation of the magnetite plus hematite. The polished sections were also analysed with the Quantimet to determine the ratio of magnetite to hematite. The hematite content is very low thus all the unliberated magnetite plus hematite was considered as unliberated magnetite.

RESULTS

The EBS-SEM photographs are shown in Figures 1 to 6. The minerals identified in the samples are magnetite, hematite, quartz, K-feldspar, plagioclase, phlogopite, mafic minerals (amphibole and pyroxene), and apatite. Traces of goethite and calcite were detected by X-ray diffractometer in Sample 200 to 270 mesh but their presence was not confirmed. The mineralogical compositions are listed in Table 2.

Table 2 - Analysed mineral contents

Mineral	Samples					
	Unsized	+200M	200-270M	270-400M	400-500M	-500M
Magnetite - free	86.3	79.0	77.3	91.1	93.9	92.7
- unliberated	4.3	9.6	10.7	2.7	1.8	1.2
Hematite	0.4	0.2	0.4	0.1	0.1	0.3
Quartz	8.5	8.1	8.4	3.7	3.4	5.3
K-feldspar plus phlogopite	0.08	2.7*	0.7	1.0	0.4	0.1
phlogopite	na	na	0.4	na	0.3	na
K-feldspar	na	na	0.3	na	0.1	na
plagioclase	nd	nd	0.8	0.3	0.2	0.02
Mafics	0.4	0.4	1.4	1.1	0.2	0.4
Goethite	nd	tr	nd	nd	nd	nd
Calcite	nd	tr	nd	nd	nd	nd
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0
Wt % of concentrate**	100.0	0.7	5.6	29.2	7.5	57.0

tr = trace

na = not analysed

nd - not detected

* = mostly K-feldspar

** = data supplied by J. Wilson

Most of the magnetite is present as free grains with the quantities of free grains increasing in the finer-sized samples. The unliberated grains are attached to the non-metallic minerals. The quantities of magnetite attached to the various minerals and the average percentage of magnetite in the combined magnetite - non-metallic mineral grains are listed in Table 3.

The K-feldspar in the samples coarser than 400 mesh is in combined K-feldspar-quartz grains, in the finer-grained samples some is free and some is in combined grains. The phlogopite in samples coarser than 400 mesh is in combined phlogopite-magnetite grains, whereas in the finer-grained samples some is free and some is combined with magnetite. The mafic minerals consist of several varieties of amphiboles and pyroxenes. Both minerals contain minor amounts of K (detected by SEM).

Table 3 - Quantities of unliberated magnetite

Other mineral in combined grain	Unsized		+ 200M		200 to 270M		270 to 400M		400 to 500M		- 500M	
	mag wt %	%* mag in av grain	mag wt %	%* mag in av grain	mag wt %	%* mag in av grain	mag wt %	%* mag in av grain	mag wt %	%* mag in av grain	mag wt %	%* mag in av grain
Quartz	4.2	49	8.7	46	10.5	56	2.0	35	1.41	31	1.14	18
Phlogopite	0.05	62	0.7	21	0.08	10	0.4	28	0.12	22	0.03	25
Plagioclase	na		na		0.07	8	0.1	28	0.03	14		
Mafic	0.06	16	0.19	37	0.1	7	0.2	15	0.22	58	0.01	50
TOTAL	4.3		9.6		10.7		2.7		1.8		1.2	

na = not analysed

* = vol %

CONCLUSIONS

1. Magnetite liberation increases with fineness of sample, 88 wt % of the magnetite is free in the 200 to 270 mesh sample and 98.7 in the minus 500 mesh sample. Most of the unliberated magnetite is combined with quartz, the magnetite content in an average combined grain decreases from about 50 vol % in the 200 to 270 mesh sample to 18 vol % in the minus 500 mesh sample.

2. The K content is due to phlogopite, K-feldspar, and mafic minerals. The phlogopite in samples coarser than 400 mesh is attached to magnetite, whereas in the finer grained samples some phlogopite is free. The K-feldspar in the samples coarser than 400 mesh is attached to quartz and mafic minerals, but in the finer-grained samples some K-feldspar is free. Some of the mafic minerals are free and some are attached to other minerals. The mafic minerals, however, contain very little K.

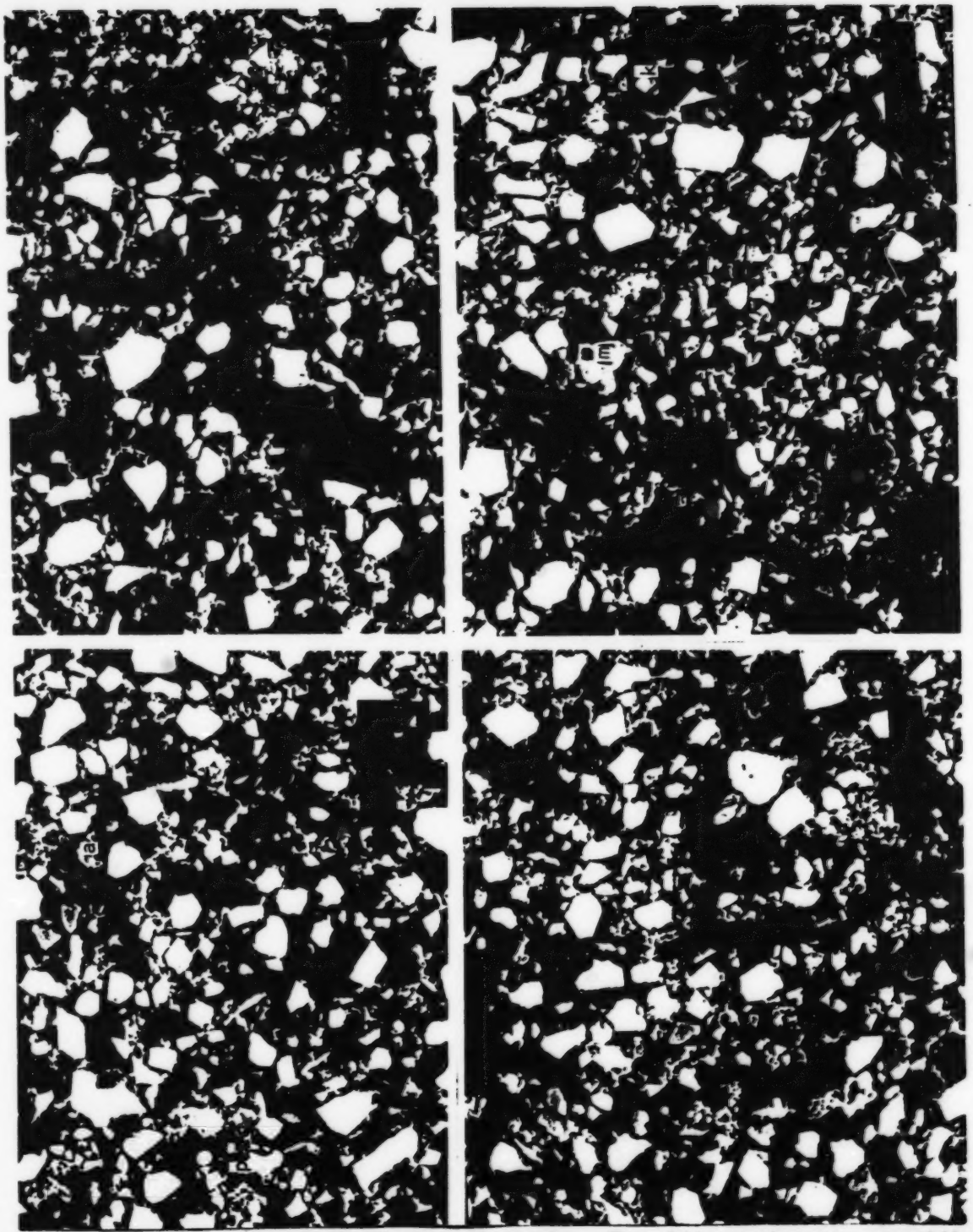

Fig. 1 - EBS-SEM photograph of unsized sample. The white grains are magnetite, the grey ones largely quartz, the one marked m is a mafic mineral. The white line is the length of 40 μm.

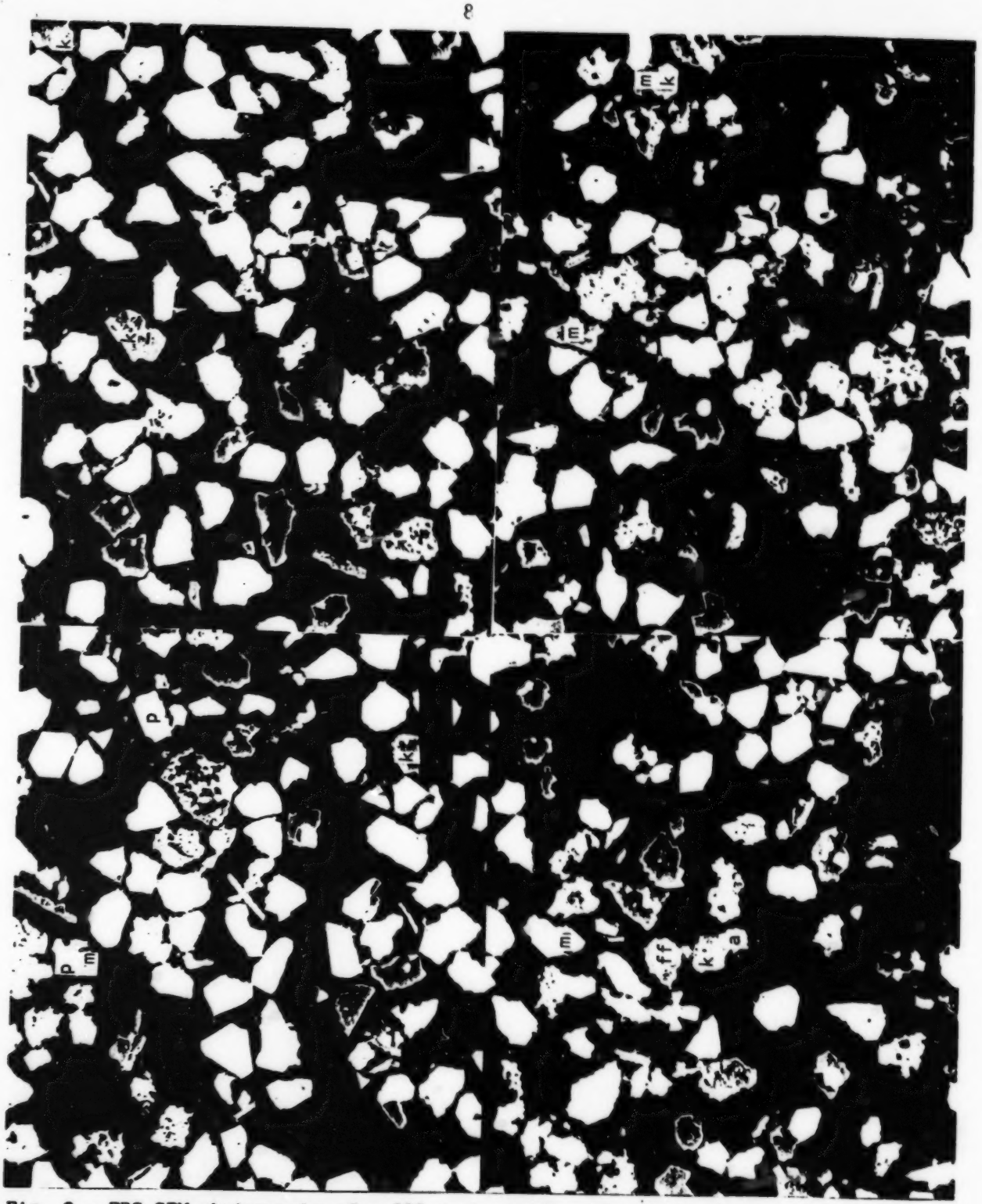

Fig. 2 - EBS-SEM photographs of + 200 mesh sample. The white grains are magnetite, the grey are quartz, p = phlogopite, m = mafic, k = K-feldspar, f = plagioclase, a = apatite. The length of the white line is 100 um.

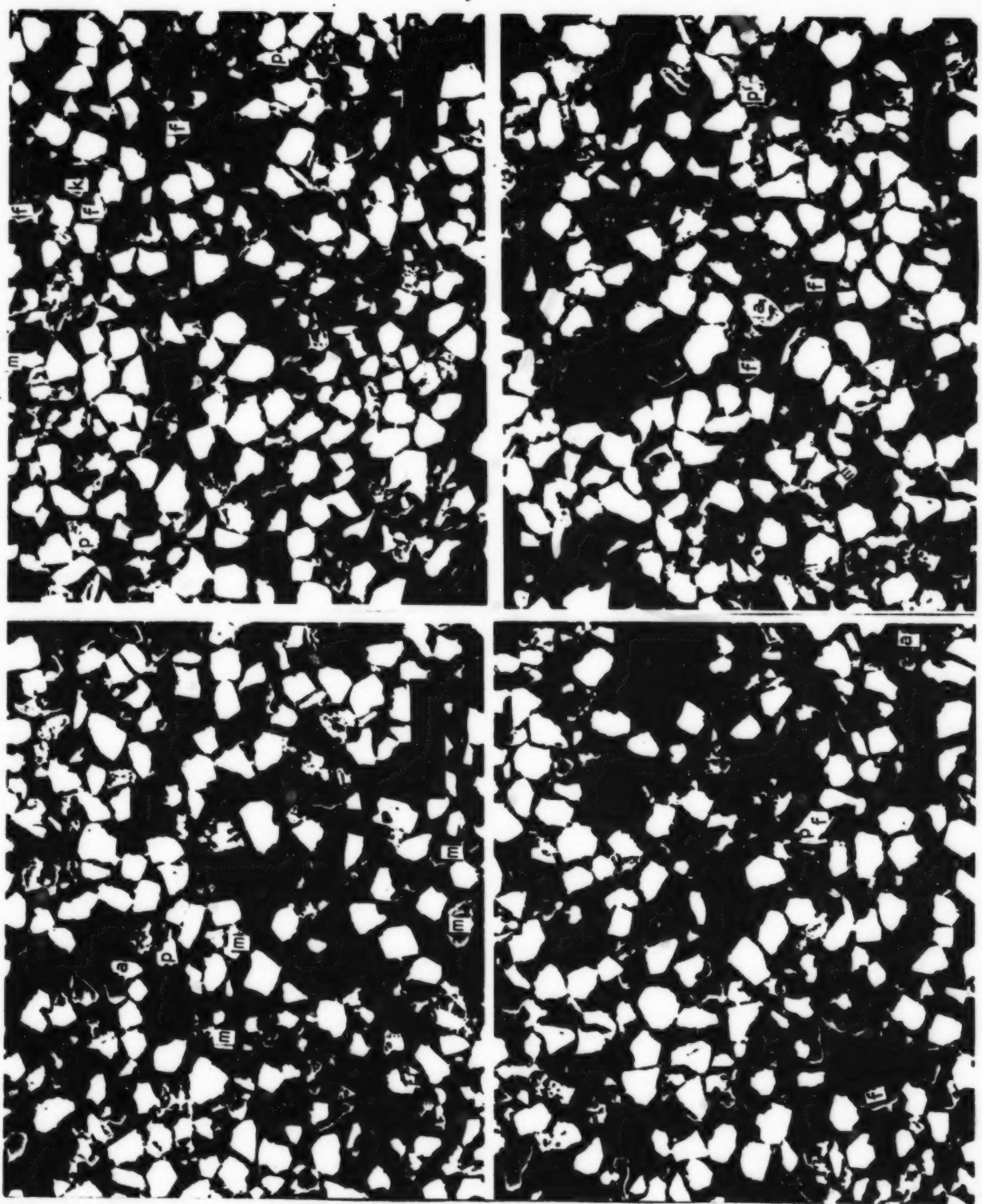

Fig. 3 - EBS-SEM photograph of 200 to 270 mesh sample. The white grains are magnetite, grey are quartz, m = mafic, f = plagioclase, p = phlogopite, k = K-feldspar, a = apatite. The length of the white line is 100 μm.

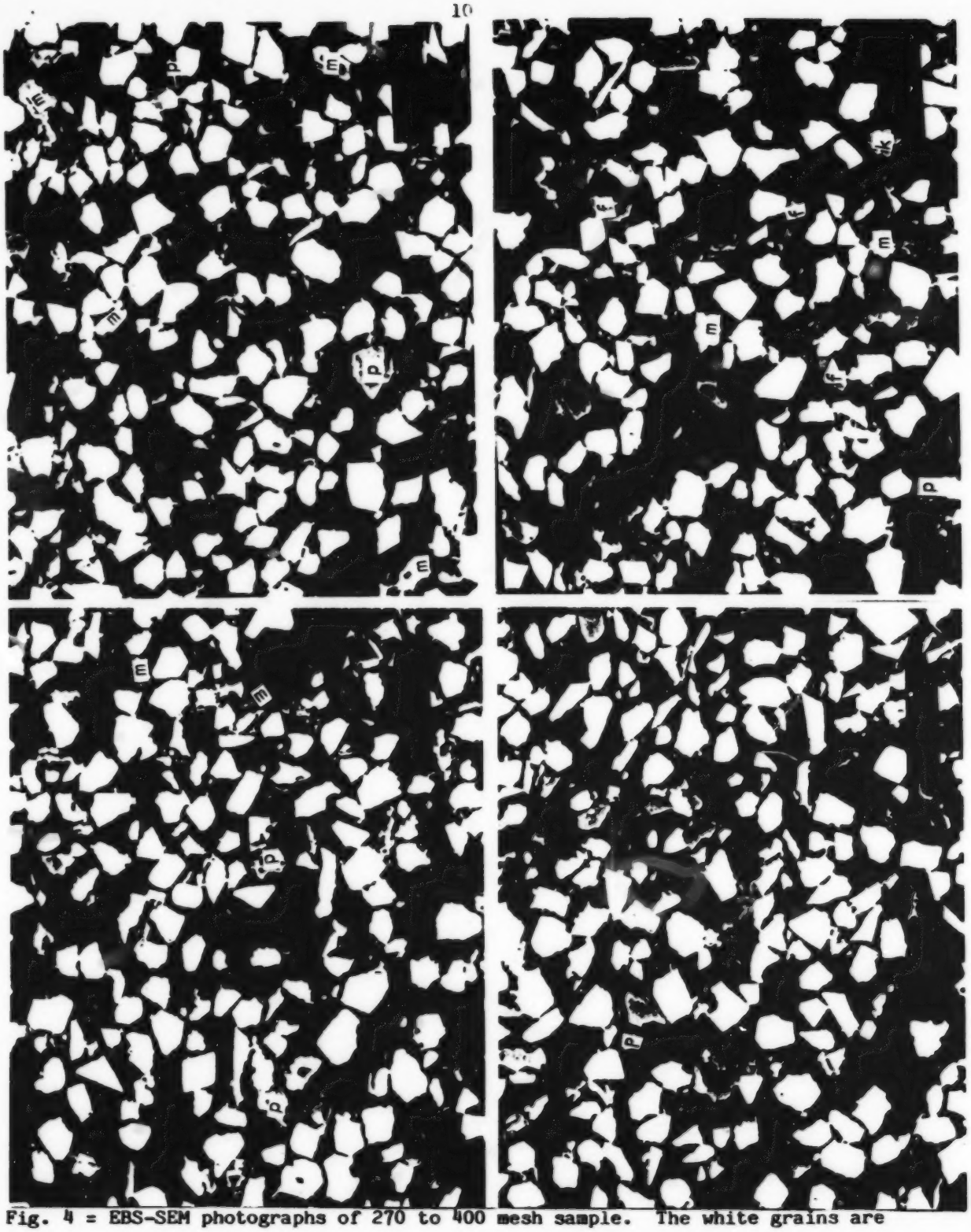

Fig. 4 = EBS-SEM photographs of 270 to 400 mesh sample. The white grains are magnetite, grey are quartz, m = mafics, f = plagioclase, p = phlogopite, k = K-feldspar. The length of the white line is equal to 40 µm.

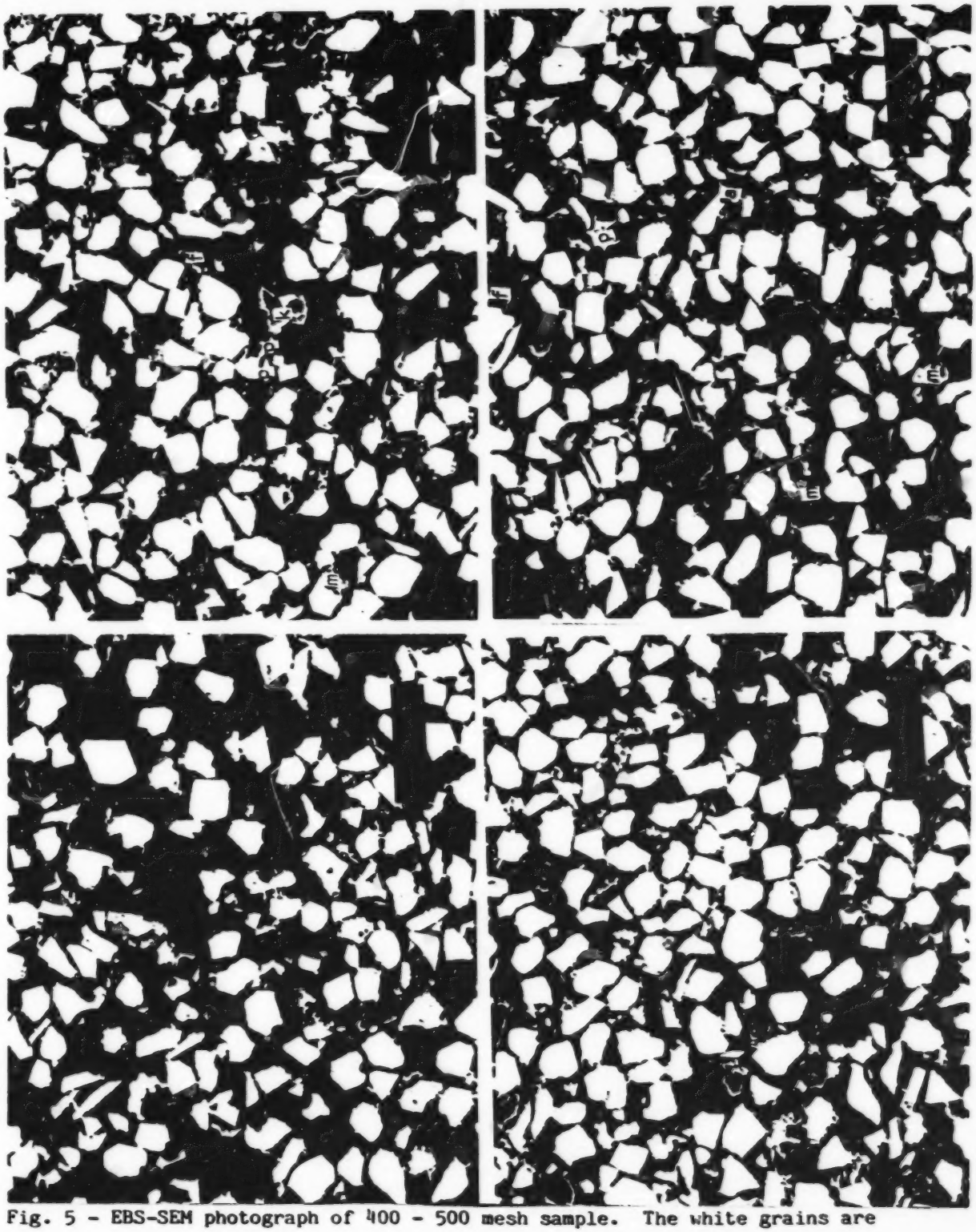

Fig. 5 - EBS-SEM photograph of 400 - 500 mesh sample. The white grains are magnetite, grey are quartz, k = K-feldspar, p = phlogopite, m = mafics. The length of the white line is 40 μm.

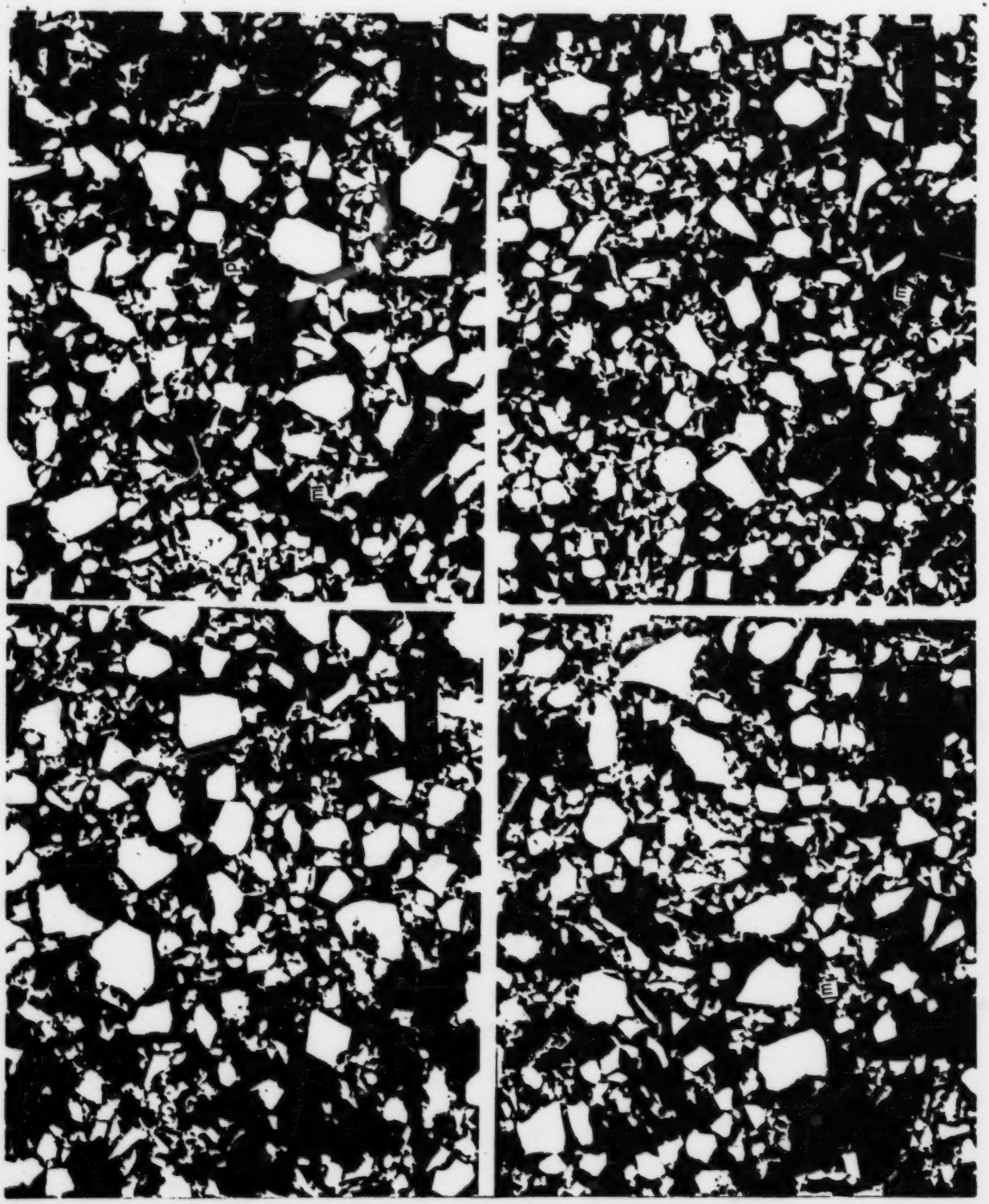

Fig. 6 - EBS-SEM photographs of minus 500 mesh sample. The white grains are magnetite, the grey are quartz, m = mafics. The length of white line is 20 μm.